

من ذكريات العمل (46)

مشروع قناطر اسنا الجديدة

نشرة دعائية من المقاول عن المشروع

الترجمة العربية للنشرة

مشروع سد إسنا الجديد ومحطة الطاقة – مصر

IMPIANTO IDROELETTRICO DI ESNA-EGITTO

شركة إمبريجيلو (Impregilo)

البيانات الأساسية للمشروع (الصفحة 2)

الجهة المتعاقدة: وزارة الأشغال العامة والموارد المائية – قطاع السدود إدارة الأعمال EUROP – EPS-SOGREAH :
(مشروع مشترك (المقاولون):

- EUROCOB – الاتحاد الأوروبي لسد إسنا (تشكل من: إمبريجيلو Impregilo سابقاً – COGEFAR إيطاليا، أنسالدو إنيرجيا – Ansaldo Energia S.p.A. إيطاليا، رومانيرجيا – Romenergia S.R.L. رومانيا

المهندسون الاستشاريون:

- Sogreah Consulting Engineers – فرنسا

تاريخ المناقصة: ديسمبر 1986 **تاريخ التعاقد:** مارس 1989 **فترة التنفيذ:** 1989-1994 :

مقدمة (INTRODUCTION)

الزراعة هي أحد أهم القطاعات الاقتصادية في مصر، وتشكل جزءاً كبيراً من الاقتصاد الوطني. يعتمد الري على نهر النيل كمصدر رئيسي للمياه. تم بناء سد إسنا القديم عام 1908 لتوفير مياه الري لمساحات زراعية واسعة. بعد ذلك، ومع تطوير مشروعات الري، أصبح السد غير كافٍ لمواجهة الاحتياجات المتزايدة، وتعرض للتآكل. لذلك قررت الحكومة المصرية إنشاء سد جديد شمال السد القديم لضمان استمرار الري وتوسيع المناطق المروية.

تاريخ المشروع وأهدافه (الصفحات 3-4)

بدءاً من عام 1978، أجرت منظمات دولية وشركات استشارية كبرى دراسات مكثفة على السد القائم، وخلصت إلى أنه لم يعد اقتصادياً لإصلاحه، وأوصت بإنشاء سد جديد أسفل السد الحالي.

بناءً على تصميم قدمته الشركة الفرنسية **سوجرياه Sogreah**، أعلنت وزارة الأشغال العامة والموارد المائية المصرية (بالتنسيق مع وزارة الطاقة) عام 1986 مناقصة دولية لبناء السد الجديد الذي يشمل أيضاً محطة كهرومائية تستغل الفرق في منسوب المياه لإنتاج أكثر من **600 جيجاوات ساعة** من الكهرباء سنوياً.

أهداف المشروع الرئيسية:

1. ضمان تنظيم أفضل لمياه الري واستخدامها بكفاءة، مما يسمح بالحفاظ على المناطق المروية وتوسيعها في المستقبل.
2. مواجهة التآكل المتوقع في قاع النهر.
3. إنتاج طاقة كهربائية باستخدام الفرق المتاح في منسوب المياه.
4. تحسين الملاحة النهرية من خلال بناء هويس (قفل ملاحى) بسعة أكبر من الهويس القديم لاستيعاب حركة المرور المتوقعة.
5. إنشاء طريق بديل على قمة السد يربط بين الضفتين.

أثارت المناقصة اهتماماً كبيراً، وعرضت عدة دول (منها إيطاليا) تمويلاً ميسراً. تقدمت **14 عرضاً** من 10 دول، وفاز التحالف الإيطالي (إمبريجيلو Impregilo كقائد للأعمال المدنية + أنسالدو إنيرجيا Ansaldo Energia للأعمال الكهروميكانيكية + رومانيرجيا) بأقل عرض. تم توقيع العقد في مارس 1989 وبدأ التنفيذ فوراً.

الوصف العام للمشروع (الصفحات 5-6)

يشمل العقد تصميم التنفيذ + الإنشاء + تدريب الكوادر + صيانة المحطة لمدة عامين.

الأعمال المدنية:

- محطة كهرباء خرسانية لـ 6 توربينات من نوع "بلب" بقدرة 15 ميغاوات لكل منها.
- مصب (spillway) خرساني به 11 فتحة وأبواب شعاعية (12×12.9 م) بقدرة تصريف قصوى 7000 م³/ثانية.
- هويس ملاحى بطول 160 م وعرض 17 م وعمق لا يقل عن 3 م.
- سد إغلاق من مواد ركامية.
- قنوات ومباني وطرق وأعمال إضافية.
- معسكرات المقاول والمهندس الاستشاري.
- حائط عازل (diaphragm wall) دائم طوله أكثر من كيلومتر وعمق 40 م.
- أعمال مؤقتة لتحويل مجرى النهر + (cofferdam) حائط عازل مؤقت طوله 2 كم.

الكميات الرئيسية:

- حفر ترابي: 2,100,000 م³
- تكريك: 2,980,000 م³
- أعمال الدبش: 2,000,000 م³
- ردوم وحماية صخرية: 910,000 م³

- حائط عازل بلاستيكي/بنتونايت: 101,000 م²

- خرسانة: 290,000 م³

- حديد تسليح: 25,900 طن

الأعمال الكهروميكانيكية:

- 6 توربينات كابلان أفقية (Kaplan) قدرة 15 ميجاوات لكل منها.

- 6 مولدات كهربائية 15 ميجاوات.

- محولات وخطوط نقل 132 كيلو فولت.

- رافعات وأبواب وجسور متحركة.

قيمة العقد والتمويل: (1989) إجمالي 160 مليون دولار أمريكي + 67 مليون جنيه مصري للأعمال المدنية + 48 مليون دولار عملة أجنبية + 18 مليون جنيه مصري + 77 مليون دولار للأعمال الكهروميكانيكية. (تم تمويل الجزء الأجنبي بشكل أساسي من خلال قرض من الحكومة الإيطالية عبر الوكالة الإيطالية للتعاون الدولي، وبمساهمات صغيرة من النمسا ورومانيا).

مرحلة التنفيذ (الصفحات 7-8)

بدأ العمل في 1 أبريل 1989.

- تم إنشاء حائط عازل (diaphragm wall) بعمق 40 متر تحت السد والسد المؤقت بواسطة شركة RODIO الإيطالية.

- صُبَّ حوالي 300,000 م³ خرسانة في 20 شهرًا (بمعدل ذروة 25,000 م³ شهريًا) باستخدام 7 رافعات برجية عملاقة.

- بعد إزالة السد المؤقت، تم تحويل الملاحة إلى الجانب الأيسر عبر الهويس، وإغلاق الجانب الأيمن بحاجز صخري، ثم بناء سد الإغلاق النهائي.

- تم تركيب كل الأجزاء الكهروميكانيكية بالتوازي مع الأعمال المدنية.

الحالة النهائية (حتى نهاية 1993): اكتملت جميع الأعمال المدنية والكهروميكانيكية، ودخلت المحطة الخدمة، وتم ربطها بالشبكة الكهربائية القومية. تعمل المحطة بكفاءة عالية وتساهم في تنظيم الري وإنتاج الطاقة الكهربائية.

الشركة المنفذة: إمبريجيلو (Impregilo S.p.A.) إيطاليا

مرفق رابط للنشرة



NEW ESNA BARRAGE AND POWER PROJECT-EGYPT
IMPIANTO IDROELETTRICO
DI ESNA-EGITTO

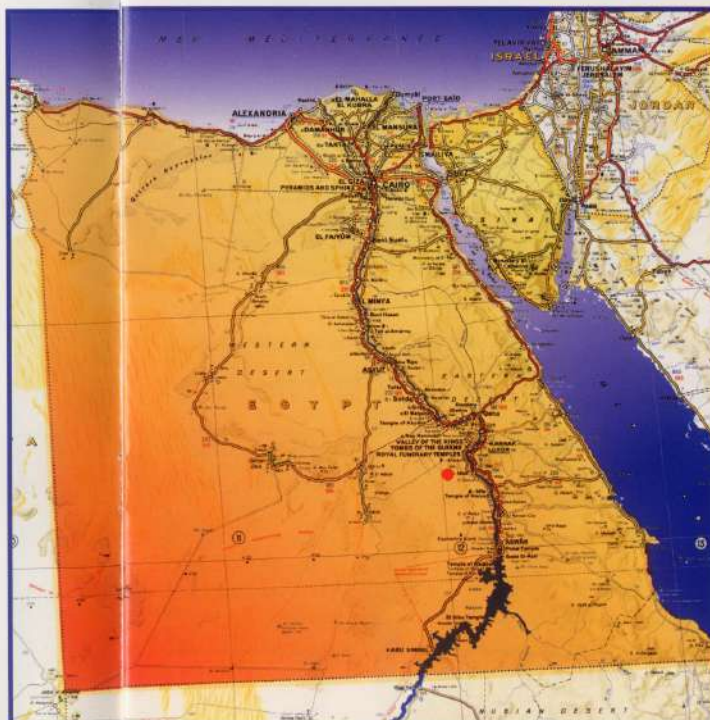
Ente Appaltante:	Ministry of Public Works and Water Resources Reservoir and Grand Barrages Sector
Direzione lavori:	EDIPCO-EPS-SOGREAH Joint Venture
Appaltatore:	"EUROCEB - European Consortium for Esna Barrage" formato da "IMPREGILO COGEFAR New Esna Barrage Joint Venture" (con IMPREGILO capofila), Italia, ANSALDO ENERGIA S.p.A., Italia ROMENERGO F.T.C., Romania
Avan-Progetto:	Sogreah Consulting Engineers - Francia
Progetto definitivo:	"EUROCEB"
Gara d'appalto:	Dicembre 1986
Firma Contratto:	Marzo 1989
Periodo di Costruzione:	1989-1994
	
Employer:	Ministry of Public Works and Water Resources Reservoir and Grand Barrages Sector
Engineer:	EDIPCO-EPS-SOGREAH Joint Venture
Contractor:	"EUROCEB - European Consortium for Esna Barrage" formed by "IMPREGILO COGEFAR New Esna Barrage Joint Venture" (with IMPREGILO leader), Italy, ANSALDO ENERGIA S.p.A., Italy ROMENERGO F.T.C., Romania
Tender Design:	Sogreah Consulting Engineers - France
Construction Design:	"EUROCEB"
Tender Date:	December 1986
Contract Signature:	March 1989
Construction Period:	1989-1994

PREMESSA

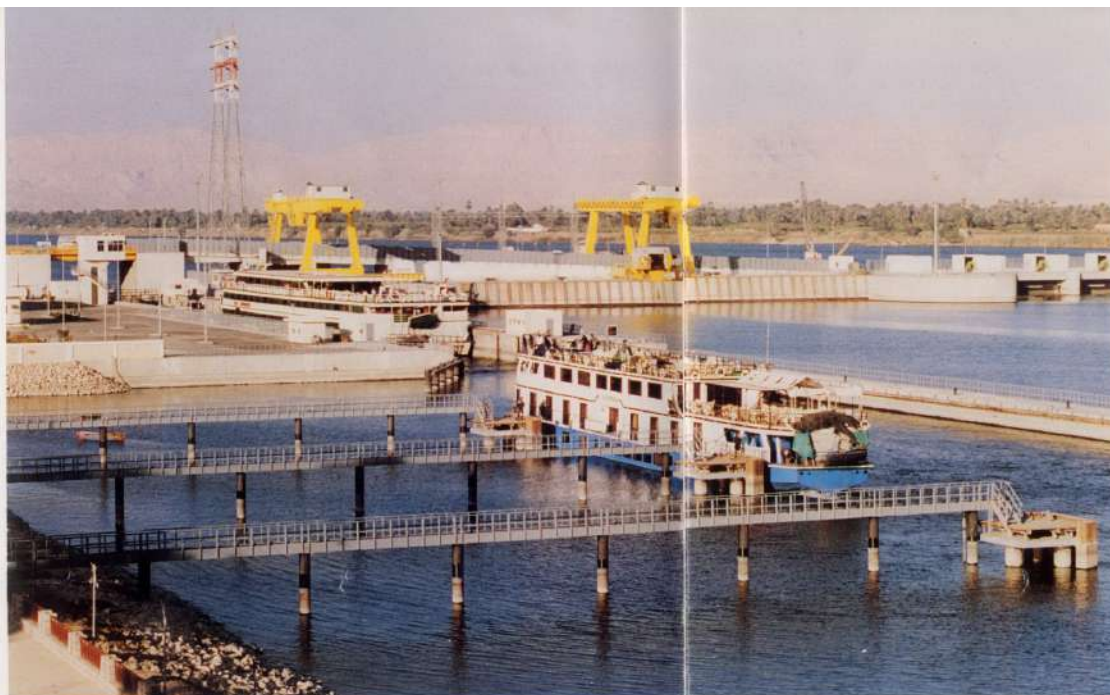
L'agricoltura è uno dei più importanti settori dell'economia egiziana ed impegna una gran parte delle forze lavoro del Paese. Il suo rendimento è condizionato dall'insufficienza di terra arabile e di riserve idriche. La vecchia diga di Esna era la risorsa principale di approvvigionamento irriguo del Governatorato di Qena per alimentare 125.000 ettari di terreno agricolo. Costruita nel 1908, con blocchi di arenaria su un centro di malta idraulica e quindi riparata e rinforzata nel 1947, si è dimostrata obsoleta, non in grado di garantire la capacità di ritenuta necessaria per le esigenze agricole, non più in grado di gestire in modo funzionale la navigazione fluviale; non sfruttava inoltre il salto disponibile per generazione di energia.

Agriculture is one of the most important sectors of the Egyptian economy and occupies a large part of the country's workforce. Its output is limited by the lack of cultivable land and water resources.

The old Esna dam was the principal source of irrigation supply for the Governorate of Qena, supplying water to 125,000 hectares of agricultural land. Built in 1908 with the piers made of sandstone rubble masonry around a centre of hydraulic mortar and then repaired and reinforced in 1947, it has become obsolete and no longer has the necessary impounding capacity required for agricultural needs, nor is it able to efficiently manage the river traffic any longer. In addition, it did not exploit the available head for electric generation.



INTRODUCTION



Panoramica vista da monte, sponda sinistra
Panoramic view from upstream, left bank

Varie organizzazioni internazionali e primarie Società di consulenza hanno svolto fin dal 1978 studi sulla diga esistente e sulle migliori soluzioni da adottare, arrivando alla conclusione che non era più conveniente fare interventi sulla vecchia diga e raccomandando la costruzione di una nuova a valle di quella esistente.

Sulla base di un progetto eseguito dalla Società francese Sogreah, il Ministero dei Lavori Pubblici e delle Risorse Idriche egiziano, d'intesa con quello dell'Energia, ha indetto nel 1986 una gara internazionale per la costruzione di una nuova diga, che incorpora anche un impianto idroelettrico in grado di sfruttare il salto disponibile producendo oltre 600 GWh all'anno di energia elettrica.

Gli obiettivi fondamentali del progetto sono così riassumibili:

- 1) Assicurare una migliore regolazione e utilizzo dell'acqua per irrigazione permettendo di mantenere ed ampliare le zone irrigate negli anni futuri.
- 2) Far fronte alle degradazioni del livello del fiume previste in futuro.
- 3) Produrre energia elettrica utilizzando il salto disponibile.

4) Permettere migliori condizioni di navigazione costruendo una chiusa con capacità di passaggio di imbarcazioni superiore a quelle della vecchia chiusa adeguata alle previsioni del traffico fluviale.

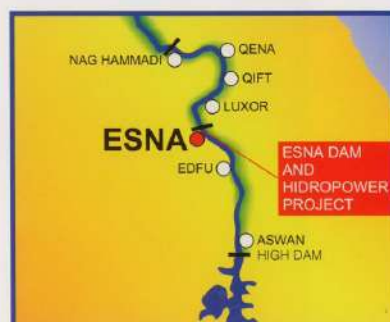
5) Costruire una strada alternativa sul culmine della diga per congiungere le due sponde.

La gara per questo progetto, altamente prioritario per il Paese, ha suscitato interesse e disponibilità alla concessione di finanziamenti agevolati da parte di varie nazioni, compresa l'Italia.

Ben 14 offerte sono state presentate e aperte pubblicamente nel dicembre 1986 da parte di Gruppi facenti capo a Società capofila di 10 paesi.

L'offerta del Gruppo Italiano costituito dalle ditte italiane Impregilo, capofila, e Cogefar (ora confluite in un'unica Società di nome Impregilo S.p.A.) per la parte civile e Gie (ora Ansaldo Energia) con una partecipazione della romana Romenergo, per la parte idromeccanica, è risultata la più bassa.

Il Contratto è stato firmato nel marzo 1989 ed è subito iniziata la costruzione.



Starting in 1978, various international organizations and major consulting companies performed studies on the existing dam and on the best solutions to be adopted, coming to the conclusion that it was no longer advantageous to repair the old dam and that a new one downstream the present one should be constructed.

Based upon a design executed by the French company Sogreah, in 1986 the Egyptian Ministry of Public Works and Water Resources, in agreement with the Ministry of Energy, announced an international tender for the construction of the new dam, which also included a hydroelectric plant capable of exploiting the available head producing over 600 GWh of electrical energy a year.

The fundamental objectives of the project may be summarized as follows:

- 1)** Ensuring better regulation and use of irrigation water, permitting irrigated areas to be maintained and expanded in future years.
- 2)** Handling the expected future erosions of the river bed;
- 3)** Producing electrical energy by using the available head;
- 4)** Permitting better navigation conditions by constructing a lock with a boat passage capacity greater than that of the old one and sufficient to meet the expected needs of the river traffic;
- 5)** Constructing an alternative road on top of the dam to connect the two banks.

The call for tenders for this project, which was of extremely high priority for the country, aroused the interest of various nations, including Italy, who expressed their willingness to contribute to the financing of the Project.

14 bids were submitted and publicly opened in December 1986 by groups leaded by companies from 10 different countries.

The offer of the Italian group, which consists of the Italian companies Impregilo, the group leader, and Cogefar (now merged in a single company known as Impregilo S.p.A.) for the civil works and GIE (now Ansaldo Energia) with the participation of the Rumanian Romenergo for the hydromechanical portion, was the best one.

The contract was signed in March 1989 and the construction began immediately.



Particolare dello sfioratore
Detail of the spillway



Rappresentazione artistica della Zona del Progetto
An artistic representation of the Project Site

- Una diga di chiusura in materiali sciolti.
- Canali, edifici, strade e opere accessorie.
- Villaggio della Direzione Lavori.
- Opere di impermeabilizzazione (diaframma permanente di oltre un Kilometro di lunghezza e circa 40 metri di profondità).
- Opere provvisorie per la deviazione: tura per mettere in secco la zona delle opere in calcestruzzo; diaframma temporaneo di circa 2km di sviluppo e 40m di profondità; aggettamenti.
- Opere e infrastrutture per la costruzione: impianti, cave, villaggi e servizi per personale esportato e locale.

Le principali quantità di lavoro sono:

• Scavi in terra	m ³	2.100.000
• dragaggi	m ³	2.980.000
• scavi in cava	m ³	2.000.000
• rilevati e protezioni in roccia	m ²	910.000
• diaframmi plastici e bentonitici	m ²	101.000
• calcestruzzi	m ³	290.000
• cassetture	m ³	198.000
• ferro per c.a.	ton.	23.500

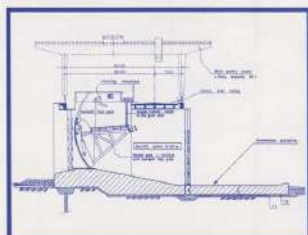
- Centrale elettrica da 90 MW comprendente:
 - n. 6 turbine orizzontali tipo Kaplan da 15 MW ciascuna, a tre pale, diametro girante 6,25m, salto nominale 5,7m.
 - n. 6 generatori da 15 MW, tensione 11KV, fattore di potenza 0,85, eccitazione Brushless.
- Impacchietture di controllo, equipaggiamento a medio e basso voltaggio, trasformatori 60/30/30MVA, linee aeree.
- sottostazione elettrica a 132KV con linea aerea di trasmissione energia.
- sistemi ausiliari, quali aria compressa, trattamento acqua, drenaggio, antincendio, condizionamento e ventilazione, ecc.
- n. 2 gru a portale da 90t.
- n. 2 gru da 15t.
- n. 11 portatote radiali per sfioratore (12x12,9 m).
- n. 6 portatote mobili per manutenzione.
- n. 1 ponte vincolare per il cancello navigabile.
- n. 1 ponte levatoio, lunghezza 17m, larghezza 12m.

Il valore iniziale del Contratto per i lavori civili è di 67 milioni di Sterline inglesi e di valute straniere equivalenti a 48 milioni di dollari; quello per la fornitura e il montaggio elettromeccanico è di 18 milioni di sterline inglesi e di 77 milioni di dollari. In totale 160 milioni di dollari ai cambi del 1989. Le componenti in valuta straniera sono state finanziate dal Governo Italiano, attraverso la Cooperazione allo Sviluppo e in parti minori da prestiti austriaci e romeni.

Il Contratto, del tipo "chiavi in mano" include la progettazione esecutiva dell'opera, la costruzione, il training di personale e la manutenzione dell'impianto per due anni e comprende le seguenti opere e macchinari:

- Una centrale in calcestruzzo atta ad alloggiare n. 6 turbine a bulbo da 15MW.

- Una sfioratore in calcestruzzo con 11 luci, adatto per paratoie radiali di 12m, possibilità di chiusura con panconcelli e in grado di smaltire una portata totale di 7000 m³/sec.
- Una conca di navigazione in calcestruzzo di 160m di lunghezza utile, 17m di larghezza e profondità minima di 3m.



Sezione dello sfioratore con paratoia radiale
Section of the spillway with radial gate

The contract includes the construction design of the Project, the construction, training of personnel and maintenance of the plant for two years and includes the following works and machinery:

Civil Works

- A concrete powerhouse for No. 6-15MW bulb turbines.
- A concrete spillway with 11 openings, suitable for 12 m radial gates with the possibility of closure by means of stoplogs and the maximum discharge capacity of 7,000 m³/sec.
- A concrete navigation lock 160 m long, 17 m wide and of minimum 3 meters draught.
- A closure dam in loose materials.

- Canals, buildings, roads and additional works.

- Employer's and Engineer's camp.

- Waterproofing operations (permanent Diaphragm Wall more than 1 kilometer long and about 40 meters deep).

- Temporary works for river diversion; cofferdam to include the area with the concrete works; temporary diaphragm wall about 2 kilometers long and 40 meters deep; dewatering.

- Works and infrastructures for the construction: plants, quarries, camps and services for foreign and local personnel.

The main quantities of works are:

• Earth excavations	2,100,000 cu m
• Dredging	2,980,000 cu m
• Quarry excavations	2,000,000 cu m
• Embankments and rock protections	910,000 cu m
• Plastic and bentonite diaphragm walls	101,000 sq m
• Concrete	290,000 cu m
• Concrete forms	198,000 sq m
• Reinforcing steel	23,500 tons

Electromechanical Works:

90 MW electric plant including:

- n. 6 Kaplan type horizontal turbines 15 MW each, with 3 blades, rotor diameter 6.25 m, nominal head 5.7 m.
- n. 6-15 MW generators, voltage 11 KV, power factor 0.85, brushless excitation.
- control systems, medium and low voltage equipment, 60/30/30 MVA transformers, aerial lines.
- 132 KV elevating switchyard with aerial transmission lines.
- auxiliary systems such as air compression, water treatment, drainage, fire prevention, air conditioning and ventilation, etc.

- n. 2 90 ton gantry cranes
- n. 2 15 ton cranes
- n. 11 radial gates for spillway (12x12.9 m)
- n. 6 sets of stoplogs for maintenance
- n. 2 gates for the navigation lock
- n. 1 Bascule bridge, 17 m long and 12 m wide.

Value of contract and financing

The initial value of the contract for the civil works is 67 million Egyptian pound and a foreign currency component equivalent to 48 million dollars; that one for the electromechanical supply and erection is 18 million Egyptian pound and a foreign currency component equivalent to 77 million dollars. The total amounts to 160 million dollars at 1989 exchange rates.

The foreign currency portions were mainly financed by the Italian Government through the Italian Agency for International Cooperation, with minor portions by Austrian and Rumanian loans.

Vista della conca di navigazione in costruzione
View of the navigation lock under construction



Dal 1 aprile 1989, data dell'ordine a procedere da parte del Cliente, sono iniziati i lavori. Sono stati costruiti i villaggi residenziali per il personale del Cliente e Direzioni Lavori e dello staff espatriato, officine, magazzini, uffici e impianti necessari per la costruzione.

Contemporaneamente si è costruito un grande argine chiuso per separare la zona del Nilo in sinistra in cui si trovano le opere in calcestruzzo: Conca di Navigazione, Centrale Idroelettrica, Sfiatore. E' stata realizzata una campagna geologica per approfondire certi dati contenuti nei documenti di gara e si è sviluppato il progetto definitivo, affidato, per la parte civile alla ditta italiana ELC-Electroconsult di Milano.

L'argine è stato impermeabilizzato con un diaframma profondo 40m e tutta la zona da esso racchiusa è stata prosciugata e mantenuta sgottata da un'apposita rete di pompe, mentre venivano eseguiti gli scavi e le opere in calcestruzzo.

Vista delle opere in calcestruzzo al riparo dell'argine durante la costruzione
View of the concrete works protected by the cofferdam during construction



Impianto di betonaggio
Concrete plant



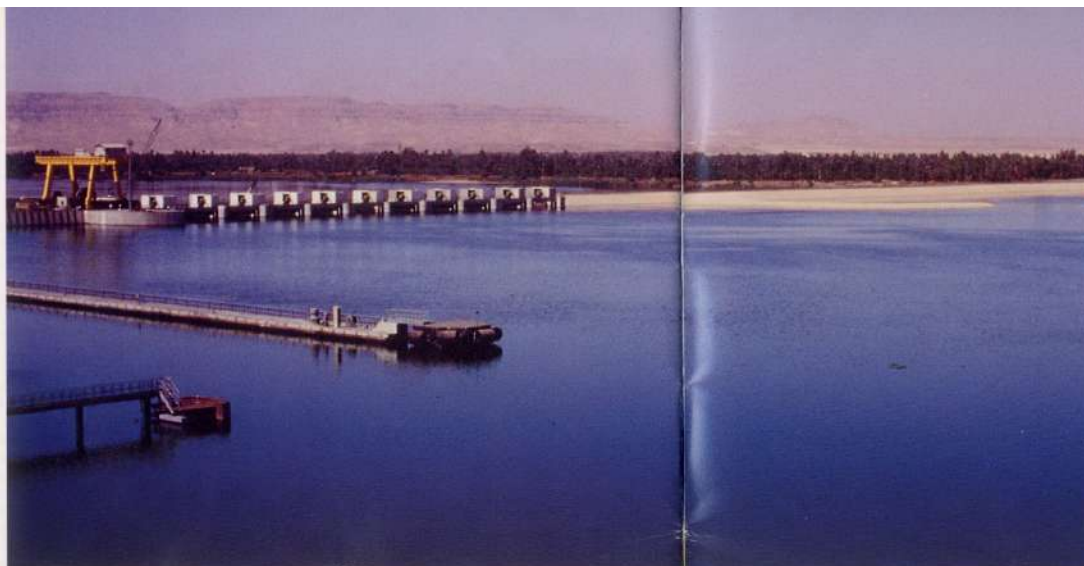
Vista della Centrale in costruzione
View of the Power House during the construction works

Essendo tutte le fondazioni delle opere in sabbia, si è ricorsi alla costruzione di paratie profonde fino a 40m, per garantire la impermeabilità. Sia la paratia sotto la diga che quella dell'argine provvisorio sono state realizzate da un gruppo di subappaltatori specializzati con capofila la RODIO di Casalmiocco (Milano).

Tutte le opere in calcestruzzo, circa 300.000m³, sono state realizzate in 20 mesi, con punte di produzione di 25.000m³ mensili.

Per i getti e le armature ci si è avvalsi di sette enormi gru a torre, scorrevoli su binario in modo da poter servire tutta l'area interessata dai getti.

Rimosso l'argine provvisorio, la navigazione lungo il Nilo è stata deviata dal lato destro del fiume a quello sinistro, attraverso la conca di navigazione; il lato destro è stato chiuso da uno sbarramento in roccia che ha costretto tutto il flusso dell'acqua a passare dagli sfiatori e quindi si è realizzata la diga di chiusura, in materiali granulari con protezioni in rockfill e diaframma di impermeabilizzazione. Contemporaneamente ai lavori civili, il Gruppo elettromeccanico ha fornito e montato le parti idromeccaniche, le turbine, le attrezzature e impianti ausiliari, le parti elettriche. Attualmente tutte le opere civili e elettromeccaniche sono terminate, l'impianto è funzionante e la centrale è collegata alla rete elettrica nazionale dalla fine del '93.



Panoramica dello sbarramento da monte
View of the barrage from upstream



Vista della conca di navigazione durante il funzionamento
View of the navigation lock during operation



Cartello indicatore del progetto all'entrata del cantiere
Project sign at the site entrance

As the entire foundation of the works is on sand, diaphragm walls up to 40 meters deep were constructed to prevent the passage of water. Both the diaphragm wall under the dam and that one in the temporary cofferdam were constructed by a group of specialized subcontractors, leaded by RODIO of Casalmaggiore (Milan).

All the concrete works, about 300,000 cu m, were constructed within 20 months, with production peaks of 25,000 cu m a month.

For concrete pouring, moving the forms and reinforcement steel placing, seven enormous tower cranes, sliding on rails were used so that they were able to serve the entire area involved in the works.

When the temporary cofferdam was removed, the navigation along the Nile was diverted from the right side of the river to the left, through the navigation lock; the right side was closed by a rock barrier which forced the entire flow of water to pass through the spillway, and then the closure dam was constructed in granular materials with protections in rockfill and a waterproofing diaphragm wall.

The works started on April 1, 1989, when the order to proceed was given. The residential camps for Employer's and Engineer's personnel, and the one for the foreign staff were built, as well as the workshops, warehouses, offices and plants necessary for the construction.

At the same time, a cofferdam was realized to separate the left zone of the Nile in which the concrete works were located: navigation lock, powerhouse, spillway.

A geologic campaign was performed in order to control and define certain basic data found in the tender documents, and the final design was developed, the civil engineering portion of which was assigned to the Italian company ELC-Electroconsult of Milan.

The embankment was waterproofed by means of a diaphragm wall 40 meters deep, and the entire area it enclosed was dewatered and kept dry by a special pump network, while the excavations and concrete works were performed.

At the same time as the civil works, the electromechanical group supplied and erected the hydromechanical parts, the turbines, the auxiliary equipment and plants and the electrical parts.

At present all the electromechanical and civil works have been completed; the facility is in operation, and the Powerhouse has been connected to the national electrical grid since late 1993.

